STEM education
ΟΡΓΑΝΙΣΜΟΣ ΕΚΠΑΙΔΕΥΤΙΚΗΣ ΡΟΜΠΟΤΙΚΗΣ,
ΕΠΙΣΤΗΜΗΣ, ΤΕΧΝΟΛΟΓΙΑΣ & ΜΑΘΗΜΑΤΙΚΩΝ

Panhellenic Competition
Educational Robotics 2024-25
Open Category
(3rd – 6th grades of Primary School)

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Contents

Description of the topic

The desire to explore is inherent in man, it is characteristic of human nature. Since ancient times, people began to explore the Earth and at the same time turned their gaze towards the sky. The search for other habitable planets is the natural extension of this desire.

Mars is the most Earth-like planet in our solar system. Studying it may provide a unique opportunity to understand the evolution of planets and the possibility of life.

The colonization of Mars is an ambitious effort that faces many challenges and requires solutions to various problems. While technology continues to advance, humans will have to resolve many critical issues before they can establish viable colonies on Mars.

Some of the main problems to be solved:

1. Transition and Landing

- **Travel Space:** The trip to Mars takes about 6-9 months with current technology. This requires robust spacecraft that can protect passengers from radiation and other hazards.
- **Landing:** Landing on Mars is complicated due to the thin atmosphere, which makes it difficult to slow down spacecraft.

2. Radiation

- **Cosmic Radiation:** Without the protection of Earth's magnetosphere and atmosphere, people on Mars will be exposed to high levels of radiation.
- **Solar Storms:** Explosions on the Sun can increase radiation in space, affecting astronauts.

3. Air and Water Supply

- **Oxygen Production:** Technologies need to be developed that will produce oxygen from carbon dioxide in the Martian atmosphere.
- **Water Supply:** Finding and extracting underground ice and recycling water is vital for survival.

4. Diet

- **Food Cultivation:** Growing food in a hostile environment with low gravity and limited resources is a big challenge.
- **Food Storage and Transportation:** Food must be kept fresh and nutritious during travel and stay.

5. Housing and Infrastructure

- **Radiation Protection:** Homes must provide protection from radiation and extreme temperatures.
- **Infrastructure Construction and Maintenance:** The construction and maintenance of houses and other structures requires the use of local materials and advanced robotics.

6. Energy

- **Energy Production and Storage:** Colonies will need energy sources to meet their needs.

7. Contact

- **Communication Delays:** Communication with Earth has a delay of 4-24 minutes, which can affect operational decisions and daily life.
- **Autonomy:** Colonies should be sufficiently autonomous and able to make decisions without direct communication with Earth.

8. Environmental Challenges

- **Extreme Temperatures:** Temperatures on Mars can range from -125°C at night to 20°C in the day.
- **Dust and Dust Storms:** Dust storms can last for weeks and cover the planet, affecting energy production and respiration.

9. Health and Medical Care

- **Access to Medical Care:** Colonies must have equipment and medicines to treat diseases and injuries.
- **Mental Health:** Isolation and harsh living conditions can affect residents' mental health

10. Social Organization and Administration

- **Organization and Administration:** The colonies will need a system of administration that manages resources and resolves conflicts.
- **Legal and Ethical Issues:** Legal frameworks for ownership, resource use, and human activity on Mars must be established.

The requirements of the competition

Motivate students to study in detail the challenges of human settlement on Mars by seeking relevant information. Ask them to imagine and propose feasible solutions for one or more challenges.

They will be evaluated

- Functional representations from smart prototypes and as applicable solutions as possible
- Demonstration of a fully functional project based on specifications
- Proper presentation of the project which will include:
    1. Verbal support in a spirit of cooperation of team members
    2. Correct answers to the judges' technical questions
    3. Complete documentation of the project with printed or digital supporting material.

Difficulty Levels

Respecting the fact that many teams participate in this competition category for the first time, the projects will be divided into two evaluation subcategories with **different level of difficulty per subcategory depending on the automations** that the participating teams will decide to implement.

The two categories are **Elementary** and **Advanced** and differ from each other in terms of requested automations.

Teams participating in the **Elementary** subcategory will have to implement E1 **and E2 automation**

The teams participating in the Advanced subcategory will have to implement the automations **E1, E2, A1 and A2**

Below is the description of the deliverables by a team participating in the Competition.

Deliverable 1

Fully Functional Mock-up (evaluation day)

Help the children create a fully functional project (mock-up) that presents the problem and the proposed solution by incorporating the automations requested by the rules of the competition. Prepare the children for a group presentation of the project on the day of the presentation of the project to the judges.

The Model of the project

On the day of the assessment, the team should present a fully functional model that represents the scenario the students have dealt with. This project should highlight the issues that troubled the students and are related to the colonization of the planet Mars as well as the solutions they propose.

Both the representation of problems for our survival on Mars and the proposed solutions can include motion mechanisms and electronic automation.

The model of the project The work should be supported by a "script narrative" that will unfold in some space. This space will be represented in the work with a model that will be the backdrop in which the automations will be integrated. On the day of the competition, each team will be allocated a "booth" with an area of approximately 150 cm x 150 cm and a vertical back of approximately 2 m height. Printed material can be glued on the back or the presentation can be projected (with a projection of the team). In the booth there will be a workbench measuring approximately 100cm x 60cm. In this space the model should be installed along with the automations. Alternatively, the team can place its work on the floor, as long as it does not exceed the boundaries of the stand. Electricity supply with power strips will be available at the kiosk. There will be no wired internet or wifi capability.

Mock-up Materials

The robotics systems with the possibility of developing free precision mechanical constructions that exist in schools for the age category we refer to are either Lego type or GIGO type. Given this, all parts of the structure that involve mechanical automation or motor-driven mechanical parts should be made with plastic building blocks of Lego, Wedo or GIGO type. The remaining parts of the structure can be made with any other material (such as foam, paper, wood, etc.) as long as it does not pose any risk to children.

The automation of the model

Automation E1 and E2

Both teams participating in the Elementary category and the teams participating in the Advanced category should present the two electronic automations E1 and E2 based on a system with a Micro:bit processor unit or the S1 automation system according to the following requests:

- Each automation includes at least one sensor, the processor and at least one motor.
- The sensor of each automation takes measurements of a physical size.
- The sensor is: internal micro:bit sensor or external sensor.
- Physical size measurements are presented on a computer screen in real-time graphics.
- Each automation is activated after comparing the sensor measurement with a specific value of the physical size (threshold).
- The physical quantities measured and used in E1 and E2 automations must be different from each other. The mechanisms or robotic systems related to the actuator motor should be different from each other.
- In both E1 and E2 automations, the corresponding motor activated in the automation should animate a mechanical structure with a specific function, or it should be part of a robotic system that includes a mechanical construction with a specific function in the project. The use of simple machines (wheel, screw, pulley, gear, lever, inclined plane, wedge) in any case is required. The two robotic or mechanical constructions are also part of the evaluation with increased gravity.

  We want all existing school systems to be used as much as possible in the competition, so we propose high interoperability software between systems (Mind+, e-code, makecode)

  Based on the educational robotics systems that exist in schools and the capabilities of the proposed software, we can mention combinations that can achieve the desired result.

  In these automations, the following are evaluated:
- The originality of automation
- The correct measurement and use of the physical size associated with the sensor
- The mechanical construction or construction of the robotic system that includes the **motor – actuator** of the mechanism.

For instance:
For the measurement and graphical display of physical size can be used
Micro:bit with internal sensor
Micro:bit with external sensor and interface board (e.g. wukond, Keyestudio)
Nezha System (Micro:bit)
Gigo Robots System (Micro:bit)
TPBot System (Micro:bit)
Wonder building kit system
System S1

For the creation of a Robotic System-Mechanism, the following systems.
WeDo system or compatible
Nezha System
Gigo Robots System
TPBot System
Wonder building kit system
S1 system (with related additions)

Especially for the S1 system which does not have building materials, as mentioned above, it can be used to measure the physical size and give activation command to one of the Wedo, or Gigo Robot robotics systems that have the ability to manufacture mechanisms. To achieve this combination, the Mind+ software can be used.

Also, especially for the S1 system, if the team does not have any of the previous educational robotics systems, we suggest that for the mechanical-robotic construction to use the building materials of the Bricks Set S1 and Nezha V1 package in combination with the motors
710155 Geekservo Angle 0-360 Degrees or 710156 Geekservo Rotation and Mind+ software. These building materials are many in number, suitable for the development of mechanisms and are accompanied by many examples. The proposed motors can be driven directly from the S1 system and are fully compatible with the building materials mentioned above.

Finally, in the context of the requested automation, the sensors of the S1 system can be used in the Gigo Robots and Wonder building kit systems

Examples for most of the above combinations will be given in a subsequent version of the document.

The programmable environment for E1 and E2 automation can be **MakeCode** or software based on **the MIT Scratch** environment such as **Mind+** or **e-code.**

The educational benefits of using electronic measurements of physical quantities

Along with the knowledge that children gain about the scientific field to which the topic of their project refers, the requested automations E1 and E2 are a very good opportunity to teach the following concepts:

- Analog and digital signals digitize the analogue magnitudes of nature.

- Units of measurement
- Measuring ranges
- Application of the concept of proportion taught in primary school
- Measurement errors
- Change in physical quantities over time
- Cartesian reference system and graph
- Dependence of physical quantities on other physical quantities

Automation E1 and E2 help children understand in depth how modern electronic devices around us use electronic sensors to examine space and make useful decisions.

Automation A1 and A2

Automations A1 and A2 are requested in addition to E1 and E2 **only** by teams that want to compete for the Advanced subcategory.

Automation A1 and A2 can only be implemented **in a programming environment based on MIT Scratch (e.g. Scratch3, Mind+, e-code)**

Automation A1 Scratch Animation

Automation **A1 Scratch Animation** It is an automation that includes sensor, processor and actuator and is mandatorily related to programming and simulation of animation in an environment based on MIT Scratch software

The operation of automation in the material world should be synchronized with a virtual digital representation - simulation of automation on the computer screen using animation in the scene of the Scratch environment.

Specifically, during the operation of the automation, the sensor input data should also be used by the simulation program so that in parallel with the automation activity, the simulated - virtual actuators are activated simultaneously and their action appears in the form of animation in the programming environment mentioned above.

The animation should:

- Represent physical automation
- Be synchronized and as simultaneous as possible with physical automation

The **educational objectives** pursued by A1 automation are:

Engage students if they have the ability and time with code of increased complexity.

Have the opportunity to express and develop their artistic creativity through digital design

Familiarize themselves with Graphical User interface (GUI) issues used in all modern computer applications for human computer communication.

Codeorama in A1 automation

Any teams they wish (but it is not mandatory for all teams), can deliver and present an analysis of the A1 automation code in the form of **Codeorama**. The educational benefit is greatest in terms of developing programmatic logic and structured thinking of students.

The teams that deliver Codeorama will compete for the **special Codeorama prize**

Deliverable 2
: A 45-minute STEM training scenario.

The process of implementing the project with the group of children is an ideal opportunity to transmit knowledge to them. Create a **complete lesson plan** which is related in any way to the implementation of the project and teach it to your students. This project will be the second deliverable of the competition. These lesson plans will be shared for the benefit of the educational community. Relevant examples as well as instructions on how to deliver will be shared in a subsequent detailed version of the document.

The main objective of this category of the competition is the integration of technology in the educational process through the STEM methodology. The measurement of physical quantities taught to children in primary school with electronic sensors was a key step of the competition in this direction and is a step won by the participants.

For the first time this year in this category, coaches are asked to deliver a 45-minute STEM lesson plan related to a part of the project and carried out using the project function. This plan should be related to a teaching unit of the school's curriculum or contain knowledge outside the curriculum that is appropriate and can be understood by the age group of the category.

The lesson plan can concern any subject (physics, chemistry, biology, mathematics, computer science, technology, language, history, visual arts, geography, environmental studies)

To illustrate this, here are some examples:

Greenhouse construction can be related to lesson plan for plant parts or growth with the process of photosynthesis etc.

Construction of an oxygen generating device can be associated with an electrolysis lesson plan or a course related to photosynthesis

Liquid water production on Mars can lead to lessons about water phase change (evaporation to extract water from the ground or liquefaction to exploit ice)

Water purifiers can be used for lesson plans on mixtures and solutions.

Housing structures that are illuminated can be used for teaching a simple electrical circuit.

Selection of spacecraft materials can lead to a course related to the physical properties of materials (electrical and thermal conductivity, density, etc.)

Processing electronic measurements or dimensional measurements in constructions to create lesson plans in mathematics

Geography lessons can be produced about the terrain of the planet and the placement of structures such as bridges in canyons or exploitation of the geographical relief for protection from solar radiation

Language and speech lessons can be related to communication and coding systems and clearly to the presentation of the project by the children or the creation of the project deliverables file.

Computer courses can be created on any programmable project system.

The code score is independent and does not affect the overall score of the group

Automation A2 Using a camera in a Scratch environment

Automation **A2,** It is an automation that uses as a sensor a camera recognized in a programming environment based on the MIT Scratch software.

The implementation of this automation is done by recognizing image patterns from the camera shots and then the action of an activator.

In Scratch-3 this is achieved by using an (internal or external USB) USB camera (still or moving), the image of which is projected as the background of the Scene. With the "video sensing" function (located in the "sensing" menu), Scratch can detect: movement, speed, color recognition or interaction with sprites already on stage. Similar and enhanced features are provided in the Scratch-like software Mind+ and e-code.

The **educational objective** of A2 automation is to familiarize students with simpler image recognition techniques and applications as a precursor to more complex AI technologies related to image, sound, or pattern recognition technologies in large data sets.

Deliverable 3

Documentation File

10 working days before the evaluation

Help the children create a digital documentation of their work and share the electronic material based on the relevant instructions which will be shared in detail in a later version of the document.

Each team should submit electronically a portfolio file containing:

A. Documents with parents' consent for the use of their photos or videos showing their faces (special printable forms that will be posted on the STEM Education website).
B. A brief description of the project (word document) highlighting the problem it solves.
C. File(s) with the program in Scratch and/or Mind+ and/or Makecode.
D. Photos showing the stages of the construction of the project and especially the constructions of the mechanisms.
E. Video where students will present describing and showing the operation of the construction, with emphasis on automation (zoom-in to show the automation) in operation and its size should not exceed 100MB. Attention: Projects whose video size will exceed 100 MB will not be included in the portfolio evaluation process.
F. Optional: The file with the code (in xls or pdf or png or jpg).

Under the responsibility of the coach, the portfolio file is submitted electronically and on time with a specific date notified by STEM Education (at least 10 days before their participation in the regional competition of their area). Projects submitted after the deadline are at the discretion of the Jury to decide whether they will participate in the ***Competition*** and be evaluated.

The presentation of the project by the students

On the day of the Competition (Regional or Final) teams must:

- install in the "booth" that will be allocated to them the mock-up, automations and sets transported prefabricated and pre-assembled,
- ensure that the establishment complies with the regulations,
- demonstrate and present their work to the public (if requested).

A limited amount **of time is allocated to each team for judging** projects (resulting from a compromise between the number of teams and the total evaluation time allocated). **Indicatively, this time may be seven minutes**, of which a part, e.g. five minutes, will be for the presentation and the rest of the time for questions from the judges.

During the evaluation of their work by the judges, the teams present their work by narrating their "innovative idea" and their invented scenario in a "theatrical way". The presentation can be supported either with a short brochure or with a Power Point in which the basic characteristics of the project are mentioned.

In a collaborative atmosphere, each member of the team, depending on the role he played during the development of the project, takes the floor and:

- mentions how their work relates to its subject
- Competition
- narrates the "script" on which the play is based and guides the judges to the
- model
- explains how automation solves the problem
- demonstrates the operation of automation
- Demonstrates the simultaneous simulation during the operation of the automation explain the code of automation, simulation and taking the sequence of measurements, optionally using the Codeorama if it has been delivered.

Indicative project evaluation criteria

The way the Competition is conducted is a live process that evolves year after year. In particular, the Regional Competition of Attica, due to the very large number of participants that asymmetrically increase the complexity of its management, presents particular problems and is often used as a pilot for the implementation of organizational changes for the Final Competition. Throughout the years of the competition's existence, the procedures carried out each time are constantly analyzed, concerns are developed, improvements are proposed, innovations are adopted and after checking if they are feasible, they are tested in practice. The result of this development is the depiction that follows in the annex "Tender Procedure".

In the Competition, the evaluation of projects is carried out by jury committees, usually consisting of experienced teachers specialized in STEM education and educational robotics. Each committee consists of 2 to 5 judges who rank the projects of the teams assigned to them. In competitions involving several teams in the final stages of the competition, all judged teams are evaluated by the same committee. In such competitions often in addition to

The jury that evaluates for the medals, there is another committee that evaluates for the individual thematic awards.

In the evaluation of the medals the judges may consult the following rubric.

Rubric (Gradebook) with indicative evaluation criteria

CATEGORIES CRITERIA GRADES				
Exploration / Conception of Idea	**TOTAL POINTS: 60**			
	1	Research and Development of Ideas		20
	2	Challenge solving thinking correctness - feasibility		20
	3	Multifaceted development of the topic / Completeness		20
Construction Mechanisms Automation	**TOTAL POINTS: 180**			
	1	Artistic image of a model, rendering environmental representation		40
	2	Mechanical constructions, use of simple machines, proper operation		20
	3	E1 Automation	Correct measurement/use of physical size 1	10
			Originality	10
			Mechanical-Robotic construction related to actuator motor	20
	4	E2 Automation	Correct measurement/use of physical size 2	10
			Originality	10
			Mechanical-Robotic construction related to actuator motor	20
	5	Automation A1 Scratch Animation	Functionality	10
			Originality	10
	6	Automation A2 Using a camera	Functionality	10
			Originality	10
Knowledge-Understanding	**TOTAL POINTS: 60**			
	1	Understanding of scientific concepts related to the project		30
	2	Good knowledge of the code, team response to relevant questions		30
Virtual World	**TOTAL POINTS: 30**			
	1	Aesthetics of digital imaging of physical automation		10
	2	Proper automation simulation	Sync with sensor	10
			Activator synchronization	10
Presentation	**TOTAL POINTS: 50**			
	1	Communication Skills - Expression		10
		Member participation		10
		Collaboration		10
		Clarity of description		10
	2	Decor, Videos, Posters		10
				MAXIMUM SCORE: 380
			Codicator Scoring (optional)	**100**

General and Special Awards per subcategory

Advance projects awarded

The Advanced subcategory leads to the following **General Awards**

Gold Advanced (3 teams)

Silver Advanced (3 teams)

Bronze Advanced (3 teams)

The Advanced subcategory also leads to the following **Special Awards:**

Special Prize for Scratch Animation

Special Camera Automation Award

Special Codiorama Award

Elementary projects awarded

The Elementary **subcategory** leads to the following **General Awards**

Gold Elementary (3 teams)

Silver Elementary (3 teams)

Bronze Elementary (3 teams)

The Elementary **subcategory** also leads to **Special Awards** which will be announced in a subsequent edition of the document

Procedure for complaints and objections

The "waterfall procedure" followed in the ***Competition*** does not allow for delays and due to this **it is not feasible** to effectively implement an objection procedure during the Competition.

Objections, complaints, objections and suggestions -in written form- are accepted, evaluated and utilized by the scientific and organizing committee of the competition, for the continuous improvement of subsequent competitions.

In our experience, the few objections to the evaluation have resulted from a lack of understanding - as a rule on the part of those who expressed them, perhaps justifiably - of the rules of the competition.

Due to the open nature of the competition, factors that do not allow a weighted and "objective" score for non-measurable (but recognizable) properties of the contestants' works such as originality, aesthetics, presentation, etc. are involved in the evaluation. Thus, from the first competition -although an indicative rubric with a quota is used for the score- the **"cup" model was adopted,** which highlights the cup winner with **successive eliminations** instead of the "championship" model that the champion emerges with the score he obtains. This "cup" model is adopted in the evaluation phases, in which groups are formed (the groups of teams that each committee will evaluate). The rubric can act as an advisory tool for jury judges.

The spatial proximity of groups belonging to different groups and the comparison between them, causes complaints of unfair treatment. The most random placement possible in the various groups of the teams is something that objectively cannot be avoided and it is the duty of the coaches of the teams to understand this way of operation and explain it to the children of their teams and to the parents.

It is important as a personal account for each child to compare himself with how he was before he was involved in the competition process and what he has conquered on his behalf and how he has evolved through his participation in the competition.

Indicative proposals to be implemented

1. **Automatic Greenhouse**: System that controls temperature, humidity and light for growing food.
2. **Water Recycler**: Unit that recycles water for reuse in everyday needs.
3. **Robotic Resource Extraction System**: Robot that collects minerals and other materials from the soil of Mars.
4. **Oxygen Plant**: System that produces oxygen from carbon dioxide in the Martian atmosphere.
5. **Radiation Resistant Residence**: Model of a house that protects against the radiation of Mars.
6. **Robotic Exploration Vehicle**: A vehicle that explores the surface of Mars and collects data.
7. **Solar Energy Plant**: Solar panels and energy storage system.
8. **Life Support System**: Automatic unit that manages air, water and waste.
9. **Robotic Assistant for Construction**: Robot that helps in the construction of buildings and other structures.
10. **Autonomous Navigation System**: Robots that can advance on the surface of Mars without human intervention.
11. **Fuel Plant**: System that generates fuel from Mars resources for future missions.
12. **Robotic Transport System**: A vehicle that transports materials and equipment to the surface of Mars.
13. **Communication System**: Network for communication between the inhabitants of Mars and Earth.
14. **Automatic Waste Management System**: Unit that manages and recycles waste.
15. **Food Production Unit**: A complex that produces food through hydroponics or other methods.
16. **Robotic Research Laboratory**: Mobile laboratory for scientific research on the surface of Mars.
17. **Climate Control System**: Unit that maintains temperature and humidity in homes and laboratories.
18. **Robotic Hazard Detection System**: System that detects physical hazards such as dust storms.
19. **Autonomous Air Purification System**: Unit that purifies and filters the air indoors.
20. **Robotic Repair Unit**: Robot that repairs equipment and buildings.
21. **Algae Food Production Unit**: Algae cultivation system for food and oxygen.
22. **Waste Recycling System**: A plant that converts waste into useful raw materials.
23. **Robotic Groundwater Research System**: Robot that detects and extracts groundwater.
24. **Automatic Building Materials Production Unit**: System that produces bricks and other materials from the soil of Mars.

25. **Robotic Health Care System**: Robot that provides medical services and care.
26. **Inventory Management System**: Automatic unit that monitors and manages food and material stocks.
27. **Robotic Hydrogen Unit**: Robot that collects, produces, uses hydrogen for energy.
28. **Energy Storage and Management System**: Batteries and energy management system.
29. **Autonomous Environmental Monitoring System**: Module that monitors environmental conditions on Mars.
30. **Robotic Road Construction Unit**: Robot that builds and maintains roads.
31. **Thermal Loss Management System**: Unit that minimizes heat losses in buildings.
32. **Autonomous Freshwater Production System**: A plant that produces fresh water from salt water.
33. **Robotic Life Detection System**: Robot that detects possible microbial life on Mars.
34. **Dust Protection System**: Unit that protects equipment from Martian dust.
35. **Autonomous Heat Generator**: System that generates heat for homes and workshops.
36. **Emergency Management System**: Unit that manages emergency and rescue situations.
37. **Autonomous Clean Fuel Production Unit**: A system that produces clean fuel from renewable sources.
38. **Robotic Ice Water or Subsoil Water Detection and Extraction System**: Robot that detects and mines ice for water.

ANNEX

Featured Competition Materials

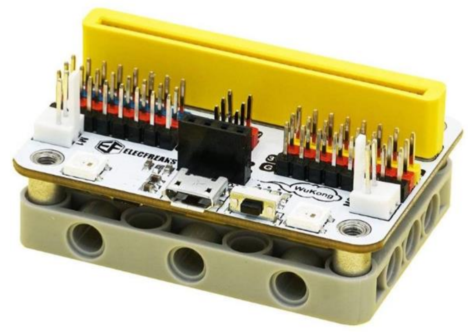
The materials proposed to be used for the implementation of automation are the materials that schools have occasionally purchased from robotics equipment programs and are compatible with the software allowed in this competition category.

The materials are described in the following tables.

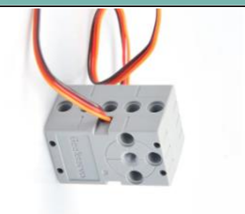
WeDo 2.0 sensors and motors or compatible:

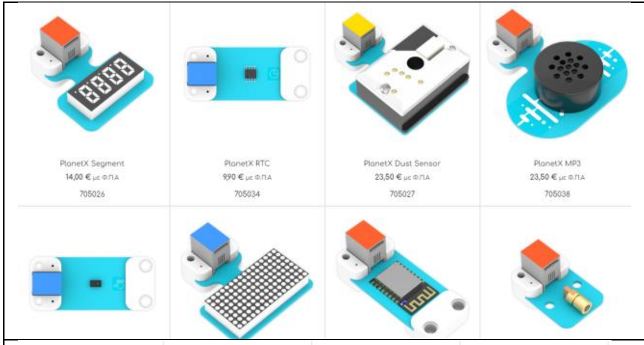
	745301 Smarthub 2
	745303 Medium Motor
	745305 tilt sensor
	745304 Motion Sensor
	777710 My First Automation
	777710R Refill Pack for My First Automation

Recommended materials compatible with Micro:bit processor

	777755 Primary School Measurement and Automation Package This material package has been tested and works perfectly with the proposed materials and software of the competition, and is supported by relevant examples. Shield for Micro:Bit Geekservo 2kg 360 Degrees compatible with Lego 360 servo motors compatible with Lego x2 Battery Mount 6xAA with Jack 5.5×2.1 LCD 1602 I2C Module Distance sensor 2-400cm HR-SR04 (digital) Octopus 1 Channel 3v Relay Module Octopus light sensor (analog) Octopus Soil Moisture Sensor (analog) Octopus LM35 Analog Temperature (analog) Octopus Water level sensor (analogue) Octopus 2 Channel Tracking Module (digital) Water Pump Jumper Wires F/F Jumper Wires M/F
	708207 micro:bit Wukong Expansion Board Adapter Micro:bit expansion board with built-in rechargeable lithium battery and Lego compatible base It supports DC motors, servo motors and sensors.
	729039 Micro:bit v2 board

	941269 Gigo Micro:Bit Compatible Robots
	708232 NEZHA Inventor's kit for micro:bit
	708288 NEZHA Inventor's kit for micro:bit v2
	708239 32 in 1 micro:bit Wonder Building Kit

	708230 TPBot Car Kit
	777784 STEM Programming S1
	708232R Bricks Set for system S1 Nezha V1 It has about 400 building engineering materials and over 100 example construction designs
  	710155 Geekservo Angle 360 Degrees 710156 Geekservo Rotation Continuous 360 Degrees 710154 DC Motor Rotation

	[Nezha and TPBot compatible units]()
	Octopus units Micro:bit compatible with very reliable support software and universal three-pin SVG connector

In a future version of the document, more detailed information as well as representative examples of automation implementation will be shared as an annex hereto

Thank you for your interest and participation.